STRAPPING MACHINE WITH STRAP FEEDING AND TIGHTENING UNIT

The present invention relates to a strapping machine, i.e. a machine of the type that wraps a package with a plastic band or strap. In particular, the present invention relates to an innovative unit for extension, retrieval and pulling the strap in the machine.

As known, in strapping machines the strap extension, pulling and retrieval unit is of basic importance for the performance achievable. Indeed, the speed at which the various operations and the quality of the final result are performed whether in terms of correct positioning of the strap or in terms of satisfactory traction of the closed strap depend on this unit. For example it is important to maintain the tension of the strap as set before the beginning of the strapping operations apart from the nature and dimensions of the package to be strapped. In addition, any fold or bend in the strap caused during the extending or pulling operations causes a strapping defect or, worse, jamming of the machine.

The purpose of the present invention is to make available a strapping machine having an extension, retrieval and pulling unit with improved characteristics to achieve high reliability and quality of the result and at the same time high cycle speed.

In view of this purpose it was sought to provide in accordance with the present invention a strapping machine comprising a strap extension, retrieval and pulling unit comprising in turn a powered main wheel around which the

strap winds partially to be moved in both directions and characterized in that there are provided two selectable mechanisms for transmission of movement to the main wheel with the first mechanism causing rotation of the main wheel at a first speed and an auxiliary traction wheel which is pressed against the main wheel with interposition of the strap near the input zone of the strap on the main wheel to effect pulling of the strap and the second mechanism causing rotating in both directions of the main wheel at a second speed greater than the first to effect extension and retrieval of the strap while the auxiliary traction wheel is at some distance from the main wheel with a control device operating alternatively the first or second mechanism to realize in rapid succession the extension, retrieval and pulling of the strap.

To clarify the explanation of the innovative principles of the present invention and its advantages compared with the prior art there is described below with the aid of the annexed drawings a possible embodiment thereof by way of non-limiting example applying said principles. In the drawings:

FIG 1 shows diagrammatically a strapping machine realized in accordance with the present invention;

FIG 2 shows an enlarged view of a strap extension, retrieval and pulling unit in the machine of FIG 1; and

FIGS 3, 4 and 5 show views of kinematic couplings and handling gears in the unit of FIG 2.

With reference to the figures, a strapping machine designated as a whole by reference number 10 comprises a

spool 11 for feeding of a strap 12, a strap extension, retrieval and pulling unit 13, and strap gripping, welding and cutting units 14, 15.

The gripping, welding and cutting units are well known in themselves and readily imaginable to those skilled in the art and therefore not further discussed or shown. In particular, the welding unit will be chosen to be suited to welding of the specific type of strap it is desired to use, for example a heat-weldable polypropylene strap. These units can be operated synchronously for example by means of an appropriate known cam-motion transmission.

FIG 2 shows in greater detail the strap extension, retrieval and pulling unit 13. This unit comprises an inlet 16 reached by the strap from the feeding spool, and an outlet 17 from which the strap is directed to the packing zone where the package or parcel to be wrapped with the strap is arranged.

The unit 13 comprises a main wheel 18 for handling the strap around which the strap winds for a relatively large arc (approximately 180° in the embodiment shown) in its path from the inlet 16 to the outlet 17. An idling inlet wheel 19 guides the strap in an arc of approximately 90° from the inlet to the main wheel 18 while a tangential guide 20 guides the strap from the main wheel to the outlet 17.

The unit also comprises a first auxiliary traction wheel 21 arranged near the inlet zone of the strap on the main wheel, a second auxiliary wheel 22 for outlet arranged near the outlet zone of the strap from the main wheel, and a third auxiliary wheel 23 arranged in an intermediate

position along the path of the strap around the main wheel. The intermediate wheel 23 comprises a rotation sensor which, as clarified below, sends a signal to a control device 50 which controls the machine operations.

The auxiliary outlet wheel 22 and intermediate wheel 23 are idling and permanently thrust against the main wheel (advantageously with pressure adjustable by cam) while the auxiliary traction wheel 21 is movable to be brought nearer to or farther from the main wheel. For this purpose the auxiliary wheel 21 is mounted on a lever 24 hinged at 25 and with one handling end 26 operated by a cam mechanism 27 and an electromagnet 28 as explained below.

FIG 3 shows diagrammatically a side view of the kinematic mechanism for operation of the main wheel 18 and the auxiliary traction wheel 21.

The wheel 18 is keyed on an axle 29 bearing a gear 30 while the wheel 21 is keyed on an axle 31 supported on the lever 24 and bearing a first gear 32 and a second gear 33. The first gear 32 is in the plane of the main wheel gear 30 while the second gear 33 is in the plane of a gear 34 which is powered by a motor 36. This is also visible respectively in FIGS 4 and 5 showing diagrammatically the transmissions in the two planes.

As may be seen in FIG 4 (where the transmission virtually in the plane of the gears 30, 32 is shown), when the lever 24 is in non-operational position, i.e. with traction wheel spaced from the main wheel, at least the pair of gears 30, 32 is mutually disengaged so that the motion of the motor 36 is not transmitted to the main wheel 18. But when the

lever 24 is in operational position, i.e. with traction wheel thrust against the main wheel, the gear pairs 30, 32 and 33, 34 are engaged and the motion of the motor 36 is also transmitted to the main wheel 18 which thus turns synchronously with the wheel 32. Transmission of motion from the motor 36 to the wheel 18 is such as to have relatively slow rotation of the wheel 18 but with power and at the same peripheral speed as the auxiliary wheel 21.

As may be seen by comparing FIGS 4 and 5, advantageously the gear pair 30, 32 has teeth with module (for example module 2) less than the module of the teeth of the gear pair 33, 34 (for example module 3), so that even when the lever 24 is in non-operational position the gear pair 33, 34 remains slightly engaged to keep the axle 31 in synchronous rotation.

For movement of the lever 24 the cam mechanism 27 comprises a cam follower 38 that is fixed to the lever by means of a pressure spring 39. Rotating the corresponding cam 46 (by means of an appropriate activation, not shown), the gears 30, 32 are engaged and the auxiliary wheel 21 is thrust against the main wheel 18 with interposition of the strap and at relatively strong force established by the spring 39 which is appropriately adjustable. A return spring 37 ensures return of the lever to the non-operational position upon release of the cam.

The lever 24 is also movable to the operational position by means of the electromagnet 28 which is connected to the lever by means of an appropriately sized elongated slot 48. As clarified below, operation of the electromagnet allows

having a first rapid movement of the lever to the operational position in such a manner as to engage the again slow moving teeth of the gear 32 with the teeth of the gear 30. A sensor 49, for example a microswitch, signals the movement of the lever corresponding to engagement of the gears.

In addition to the first rotation mechanism controlled by the wheel 18 described above, the machine comprises a second rotation mechanism that moves the main wheel 18 in both directions at a higher speed when the first rotation mechanism is disconnected.

As may be seen in FIG 4, said second rotation mechanism in a preferred realization comprises a series of two identical gears 40, 41 that engage the gear 30 integral with the main wheel 18. As shown diagrammatically in FIG 4, each gear of the series has its own shaft connected to a motion transmission 42 (for example leading to the same motor 36) through respective clutches 43 and 44 engageable on command. The gear 41 also has an electromechanical brake 45.

In this manner, by operating either of the clutches 43, 44 the main wheel 18 is commanded to rotate in one direction or the other with no need of reversing motor rotation.

During operation of the strapping machine in a first step the strap is fed forward to allow winding of a package to be strapped. For this purpose the lever is kept in its non-operational position so that the low-speed rotation mechanism is kept inactive and the control device 50 engages the clutch 43. The main wheel 18 therefore rotates clockwise at relatively high speed as shown in FIG 2 and feeds the

strap from the spool to the strapping zone. The auxiliary wheel 22 near the outlet of the main wheel is adjusted to exert pressure of the strap against the main wheel to have the necessary traction of the strap from the spool holder.

The feeding step being completed, the control device deactivates the clutch 43 and engages the clutch 44 possibly after having braked movement of the wheel by means of the brake 45. Rotation of the main wheel is therefore reversed and the strap is retrieved again at the same relatively high speed to carry it adhering to the package.

In this step the auxiliary wheel 22 has little influence as it is on the inlet side of the strap on the main wheel and the force of traction is essentially determined by the pressure of the second auxiliary wheel 23. Traction is set so that when the strap has been retrieved enough to enter in close contact with the package the strap itself begins to slide on the main wheel. The sensor on the wheel 23 detects the stopping of the wheel 23 and signals it to the control device. The control device 50 deactivates both the clutches 43, 44 to disable the high speed rotation mechanism possibly with even a short braking of the brake 45 to dissipate the inertia of the main wheel.

After this the control device 50 commands the electromagnet 28 to engage the gear 32 on the gear 30. As soon as the sensor 49 signals completion of the first engagement travel of the teeth, the cam mechanism 27 is operated and thrusts the wheel 21 against the main wheel 18 at the predetermined relatively high pressure. Thanks to the transmission just engaged, the main wheel continues to rotate counterclockwise

but at lower speed. The strap is thus drawn at reduced speed and greater force thanks to the combined action of the main wheel and the auxiliary wheel 21 to allow correct tensioning of the strap.

When the correct strap tension is reached (by timed control or detection of the condition of new sliding of the strap on the main wheel or even by control of the torque transmitted by the motor), the pulling cycle is concluded and the welding and cutting devices of the strap closed around the package are activated. The machine is thus ready for another strapping.

It is now clear that the predetermined purposes have been achieved by making available a strapping machine with a strap extension, retrieval and pulling device allowing high speeds in the strap extension and pulling steps and a precise and effective traction of the strap in all strapping steps. All with a simple, stout, reliable and economical mechanism.

With the machine in accordance with the present invention it is possible for example to realize an entire strapping cycle in 3 seconds.

Naturally the above description of an embodiment applying the innovative principles of the present invention is given by way of non-limiting example of said principles within the scope of the exclusive right claimed here. For example the auxiliary traction wheel 21 could also have a toothed surface to offer increased tractive force. The machine could also comprise other known devices or accessories in this type of machine.